UNIVERSITI PUTRA MALAYSIA

EFFECTIVENESS OF ENTOMOPATHOGENIC HYPHOMYCETES TOWARDS CONTROLLING THE BROAD MITE, *Polyphagotarsonemus latus* (Banks) AND THE RED SPIDER MITE, *Tetranychus urticae* Koch Complex

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By

IHSAN NUGROHO

Thesis Submitted to the Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

December 2003

DEDICATION

To my wife Murtafi'ah and my twin children Ahmad Afif Nugroho, Annisa Afifah Nugroho and Ahmad Aziz Nugroho

For their sacrifices, support, and strength.

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science.

EFFECTIVENESS OF ENTOMOPATHOGENIC HYPHOMYCETES TOWARDS CONTROLLING THE BROAD MITE, *Polyphagotarsonemus latus* (Banks) AND THE RED SPIDER MITE, *Tetranychus urticae* Koch Complex

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Chairman : Professor Yusof Bin Ibrahim, Ph.D.

Faculty : Agriculture

The red spider mite, *Tetranychus urticae* Koch Complex and the broad mite, *Polyphagotarsonemus latus* (Banks) are serious pests on many agricultural and ornamental crops. They are distributed worldwide and polyphagous on vegetables especially those under shelter and fruit crops. In Malaysia strawberries are usually damaged by the red spider mite while the broad mite is a serious pest on chilli. Chemical insecticides have been the mainstay for controlling these mites.

In recent year, the use of microbial control agent such as *Bacillus thuringiensis* has become increasingly attractive as a biocontrol agent and has become important as one of the biological control

components in IPM programmes. In this respect, the potential of entomopathogenic fungi including *Beauveria bassiana* (Bals.) Vuill., *Metarhizium anisopliae* (Metch) Sorokin and *Paecilomyces fumosoroseus* (Wise) Brown Smith were investigated as microbial control agents against the red spider mite *T. urticae* and the broad mite *P. latus* in the laboratory. Field efficacies of selected isolates in wettable powder formulations were also assessed against the broad mite on chilli.

Pathogenicity tests indicated that the above mentioned three isolates were able to cause significant mortalities on the larvae, nymph and adult red spider mite *T. urticae* and broad mite *P. latus*. *Paecilomyces fumosoroseus* (PfPp) was the most pathogenic against the red spider mite followed by *M. anisopliae* (MaPs) and *B. bassiana* (BbGc), while *B. bassiana* (BbGc) was the most infective against broad mite followed by *P. fumosoroseus* (PfPp) and *M. anisopliae* (MaPs).

Wettable powder formulations of entomopathogenic fungi as mycoinsecticides were very effective in suppressing broad mite population on chilli plants in the field. Formulations of *B. bassiana* (BbGc) and *P. fumosoroseus* (PfPp) significantly reduced the mite population and provided high percentage of shoot recovery by the

fourth spray schedule compared to the control. Infested shoots treated with wettable powder formulation of *B. bassiana* (BbGc) resulted in 93.33% recovery which was significantly compared to Amitraz (96.33%). However, Amitraz was able to suppress the mite population faster than *B. bassiana* (BbGc); complete annihilation of the mite population was achieved after the second spraying with Amitraz. Nevertheless, the wettable powder formulation of *B. bassiana (*BbGc) was as effective as the acaricide Amitraz by the last observation. A succession of four sprays at five day interval of mycoinsecticide was needed to suppress the broad mite population in the chilli field.

In the current study, it was believed that horizontal transmission did occur via infected mite cadaver which produced and released millions of infectious conidia although temperature and other environmental factors could affect dispersal. Fungal pathogen would established in a continuous cropping system and become an additional microbial agent in natural enemy complex, and as an important component in an IPM programme.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KEBERKESANAN ENTOMOPATOGEN HYPHOMYCETE KE ATAS HAMAMA LEBAR, *Polyphagotarsonemus latus* Banks DAN HAMAMA LELABAH MERAH *Tetranychus Urticae,* Koch Complex

Oleh

IHSAN NUGROHO

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Hamama lelabah merah *Tetranychus urticae* Koch Complex dan hamama lebar *Polyphagotarsonemus latus* Banks, merupakan perosak utama tanaman-tanaman pertanian dan hortikultur. Taburan kedua-duanya meluas seluruh dunia dan bersifat polyfagus, terutamanya merosakkan tanaman sayuran bawah naungan dan buah-buahan. Di Malaysia, hamama lelabah merah biasanya menyerang tanaman strawberi sedangkan hamama lebar amat serius pada pokok cili. Sehingga kini racun serangga adalah yang diutamakan dalam pengawalan hamama ini.

Dalam masa-masa terdekat ini, penggunaan mikrob sebagai agent kawalan biologi sepertimana *Bacillus thuringiensis* semakin

meningkat dan menjadi penting sebagai salah satu komponen kawalan biologi dalam program kawalan perosak bersepadu. Berkaitan hal ini, potensi kulat entomopathogen termasuk *Beauveria bassiana, Metarhizium anisopliae* dan *Paecilomyces fumosoroseus* sebagai agen kawalan mikrob telah diuji ke atas hamama lelabah merah dan hamama lebar di makmal. Penilaian efikasi di lapangan untuk beberapa pencilan terpilih dalam formulasi serbuk basah dilakukan ke atas lelabah lebar pada pokok cili.

Ujian kepatogenan menunjukkan ketiga-tiga pencilan tersebut di atas berupaya menyebabkan kematian yang signifikan ke atas larva, nimfa dan dewasa hamama lelabah merah serta hamama lebar dewasa. *Paecilomyces fumosoroseus* (PfPp) ialah yang paling patogenik keatas hamama lelabah merah diikuti oleh *M. anisopliae* (MaPs) dan *B. bassiana* (BbGc), manakala *B. bassiana* (BbGc) ialah yang paling menjangkiti hamama lebar diikuti oleh *P. fumosoroseus* (PfPp) dan *M. anisopliae* (MaPs).

Formulasi serbuk basah kulat entomopathogen sebagai mikoinsektisid didapati sungguh berkesan dalam menindas populasi lelabah lebar pada pokok cili di lapangan. Formulasi mengandungi *B. bassiana* (BbGc) dan *P. fumosoroseus (*PfPp)

dapat mengurangkan populasi hamama dengan bermakna dan memberi peratus pemulihan pucuk cili yang tinggi selepas semburan ke empat berbanding kawalan. Pucuk yang diserang telah pulih sebanyak 93.33% setelah dirawat dengan formulasi serbuk basah *B. bassiana* (BbGc) setanding dengan Amitraz (96.33%). Bagaimanapun, Amitraz berupaya menindas populasi hamama lebih cepat daripada *B. bassiana* (BbGc); pemusnahan populasi hamama dicapai selepas dua kali semburan. Empat kali semburan berturut-turut 5 hari berselang, diperlukan untuk menindas populasi hamama lebar pada pokok cili di ladang.

Dalam kajian ini dipercayai transmisi mendatar telah berlaku melalui hamama yang telah dijangkiti yang mana menghasilkan banyak konidia sungguhpun suhu dan lain-lain faktor persekitaran boleh menjejaskan sebaran. Kulat entomopathogen akan bertapak dalam sistem tanaman yang berterusan sebagai tambahan kepada salah satu agent mikrob di dalam kompleks musuh semulajadi, dan sebagai komponen penting dalam Program Pengawalan Perosak Bersepadu.

ACKNOWLEDGEMENT

Above all, I would like to thank Allah S.W.T., Most Gracious, Most Merciful, for his compassion and Mercy.

I would like to express my deep sense of gratitude and appreciation to my supervisor, Professor Dr. Yusof Bin Ibrahim for his advice, guidance and constructive critics in connection with the research and preparation and revisions of this manuscript. I also like to thank my committee members; Professor Dr. Ahmad Said Sajap and Associate Professor Dr. Rohani Ibrahim thank for their helpful insight and suggestion in this study.

I gratefully acknowledge Integrated Pest Management for Smallholder Estate Crops, Plant Quarantine Component Project of Indonesian Agriculture Quarantine Agency for providing me the financial support which enables me to complete this degree.

A special note of thanks goes to my friends, colleagues and staff members of Plant Protection Department, Faculty of Agriculture UPM.

I would like to express my deepest thanks and appreciation to my mother and brothers for their encouragement, support and endless prayers during my study in UPM. This endeavor would not have been feasible without their sacrifices, patience, understanding and encouragement from my dearest wife Murtafi'ah and my twin children Ahmad Afif Nugroho, Annisa Afifah Nugroho and Ahmad Aziz Nugroho.

I certify that an Examination Committee met on December 15, 2003 to conduct the final examination of Ihsan Nugroho on his Master of Science thesis entitled "Pathogenecity of Entomopathogenic Hyphomycetes on the Broad Mite, *Polyphagotarsonemus latus* (Bank) and the Red Spider Mite, *Tetranychus urticae* Koch Complex" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirements for the degree of Master of Science.The members of the Supervisory Committee are as follows :

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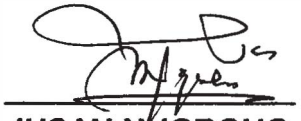
Date : 12 MAR 2004

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



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